CLAIMS

1. A laser processing method for irradiating an object to be processed with a first laser beam while converging the first laser beam with a lens such that a converging point is positioned within the object, and forming a modified region within the object along a line to cut in the object; the method comprising:

a displacement acquiring step of acquiring a displacement between a point on the line to cut and one end of the line to cut while irradiating the object with a second laser beam for measuring a displacement of a main surface of the object and detecting reflected light reflected by the main surface in response to the irradiation;

a position setting step of setting an initial position for holding the lens with respect to the main surface of the object according to the acquired displacement; and

a processing step of forming the modified region in one end part of the line to cut upon irradiation with the first laser beam while holding the lens at the initial position, releasing the lens from being held at the initial position after forming the modified region in the one end part, and then forming the modified region while adjusting the position of the lens.

2. A laser processing method according to claim 1, wherein the second laser beam is emitted without emitting the first laser beam in the displacement acquiring step.

3. A laser processing method according to claim 1, wherein the first and second laser beams are converged by the lens so as to irradiate the object on the same axis.

4. A laser processing method according to claim 1, wherein the displacement is acquired from a point on the line to cut toward one end of the line to cut in the displacement acquiring step.

5. A laser processing method according to claim 1, wherein the quantity of reflected light of the second laser beam is also acquired in the displacement acquiring step; and

wherein the initial position is set according to the displacement at a location where the acquired quantity of light becomes a predetermined threshold in the position setting step.

6. A laser processing method according to claim 1, wherein the quantity of reflected light of the second laser beam is also acquired in the displacement acquiring step; and

wherein the initial position is set according to the displacement at a location where the acquired quantity of light becomes a predetermined threshold in the position setting step.

7. A laser processing method according to claim 1, wherein, in the processing step, the second laser beam is emitted to the main surface of the object to be processed, and the lens is released from being held at the initial position according to the quantity of reflected light reflected by the main surface in response to the emission.

8. A laser processing method according to claim 7, wherein, in the processing step, the lens is released from being held at the initial position after an amount of change in the quantity of reflected light becomes a maximum value.

9. A laser processing method according to claim 7, wherein, in the processing step, the lens is released from being held at the initial

position after the quantity of reflected light becomes a predetermined threshold.

10. A laser processing apparatus for irradiating an object to be processed with a first laser beam while converging the first laser beam with a lens such that a converging point is positioned within the object, and forming a modified region within the object along a line to cut in the object; the apparatus comprising:

a lens for converging the first laser beam and a second laser beam for measuring a displacement of a main surface of the object onto the object;

displacement acquiring means for acquiring the displacement of the main surface by detecting reflected light reflected by the main surface in response to irradiation with the second laser beam;

moving means for moving the object and the lens relative to each other along the main surface;

holding means for holding the lens such that the lens freely advances and retracts with respect to the main surface; and

control means for controlling respective behaviors of the moving means and holding means;

wherein, while emitting the second laser beam, the control means controls the moving means so as to move the object and the lens relative to each other along the line to cut, the displacement acquiring means acquiring the displacement between a point of the line to cut and one end of the line to cut, the control means controlling the holding means so as to hold the lens at an initial position set according to the acquired displacement;

wherein, while emitting the first laser beam with the lens being held at the initial position, the control means controls the moving means so as to move the object and the lens relative to each other along the line to cut, thereby forming the modified region in one end part of the line to cut; and

wherein, after forming the modified region in the one end part, the control means controls the holding means so as to release the lens from being held at the initial position and hold the lens while adjusting a position of the lens, and controls the moving means so as to move the object and the lens relative to each other along the line to cut.

11. A laser processing apparatus according to claim 10, wherein the second laser beam is emitted without emitting the first laser beam when the control means controls the moving means so as to move the object and the lens relative to each other along the line to cut while the displacement acquiring means acquires the displacement between a point of the line to cut and one end of the line to cut.

12. A laser processing apparatus according to claim 10, wherein the lens converges the first and second laser beams onto the object on the same axis.

13. A laser processing apparatus according to claim 10, wherein the control means controls the moving means so as to irradiate the line to cut from a point thereof toward one end thereof with the second laser beam; and

wherein the displacement acquiring means acquires the displacement from the point on the line to cut toward the one end of the line to cut in response to the irradiation with the second laser beam.

14. A laser processing apparatus according to claim 10, wherein the displacement acquiring means also acquires the quantity of reflected light of the second laser beam; and

wherein the control means sets the initial position according to the displacement at a location where an amount of change in the acquired quantity of light becomes an extreme value.

15. A laser processing apparatus according to claim 10, wherein the displacement acquiring means also acquires the quantity of reflected light of the second laser beam; and

wherein the control means sets the initial position according to the displacement at a location where the acquired quantity of light becomes a predetermined threshold.

16. A laser processing apparatus according to claim 10, wherein the control means controls the holding means so as to release the lens from being held at the initial position according to the quantity of reflected light of the second laser beam.

17. A laser processing apparatus according to claim 16, wherein the control means controls the holding means so as to release the lens from being held at the initial position after an amount of change in the quantity of reflected light becomes a maximum value.

18. A laser processing apparatus according to claim 16, wherein the control means controls the holding means so as to release the lens from being held at the initial position after the quantity of reflected light becomes a predetermined threshold.